

Surface Atmosphere Radiation Budget (SARB) working group update

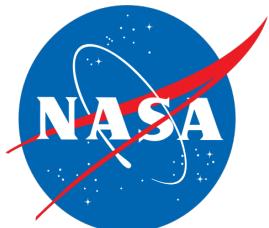
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CERES Science team meeting

May 16-18, 2017

Hampton, VA



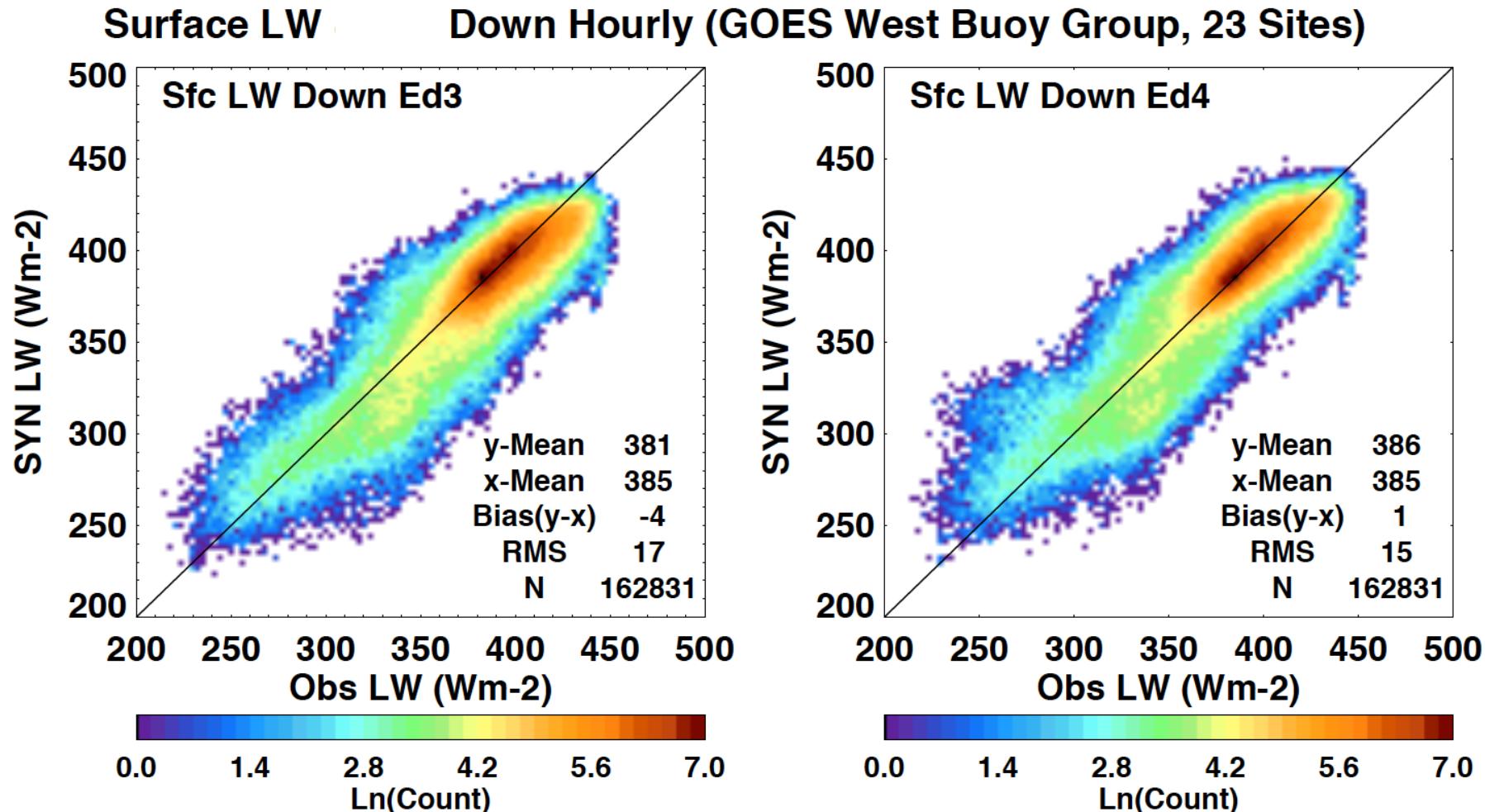
Work done after the last CERES meeting

- Evaluation of Ed4 SYN (with ship, buoy, and land sites data)
- Start revising C3M
- Production of Ed2.8 EBAF-surface (currently available through August 2016)
- Development of the algorithm of Ed4 EBAF-surface
- Start evaluating GMAO products, MERRA2 and FP (Ham's presentation)
- Evaluation of the effect of multi-layer cloud on surface radiation
- Evaluation of permanent snow BRDF observations and model derived from the observations (Radkevich's presentation)

Evaluation of Ed4 SYN

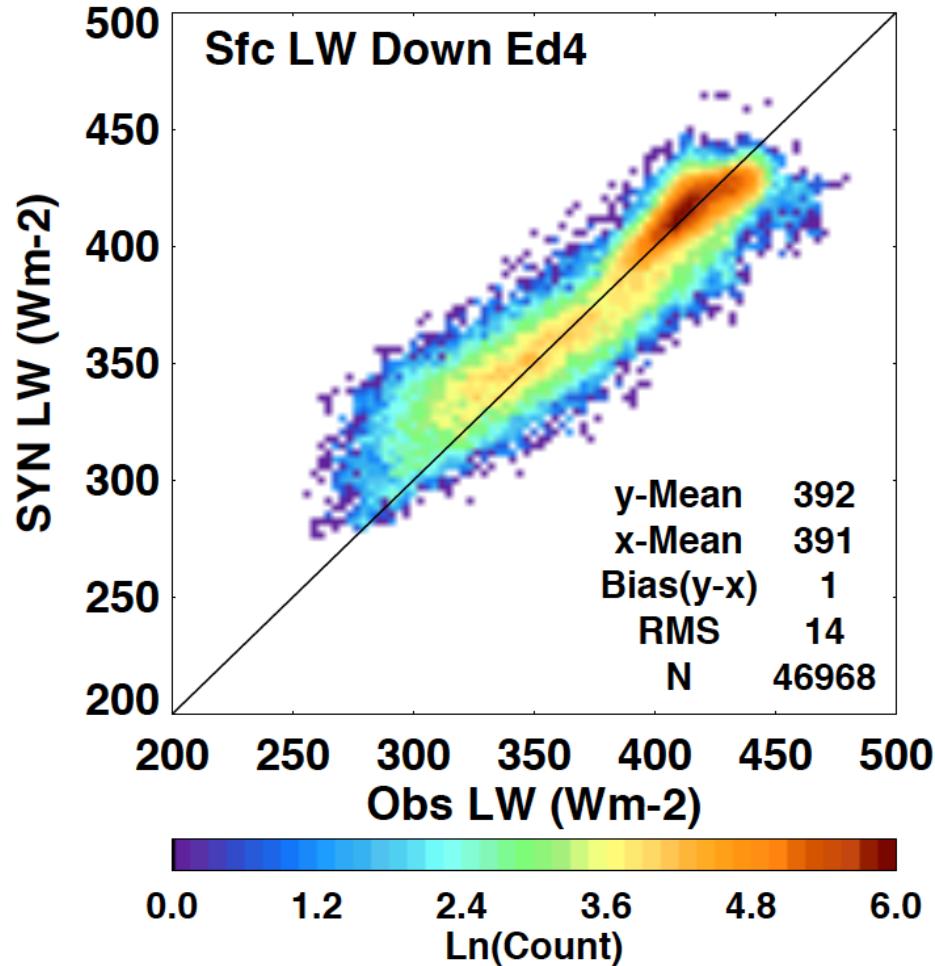
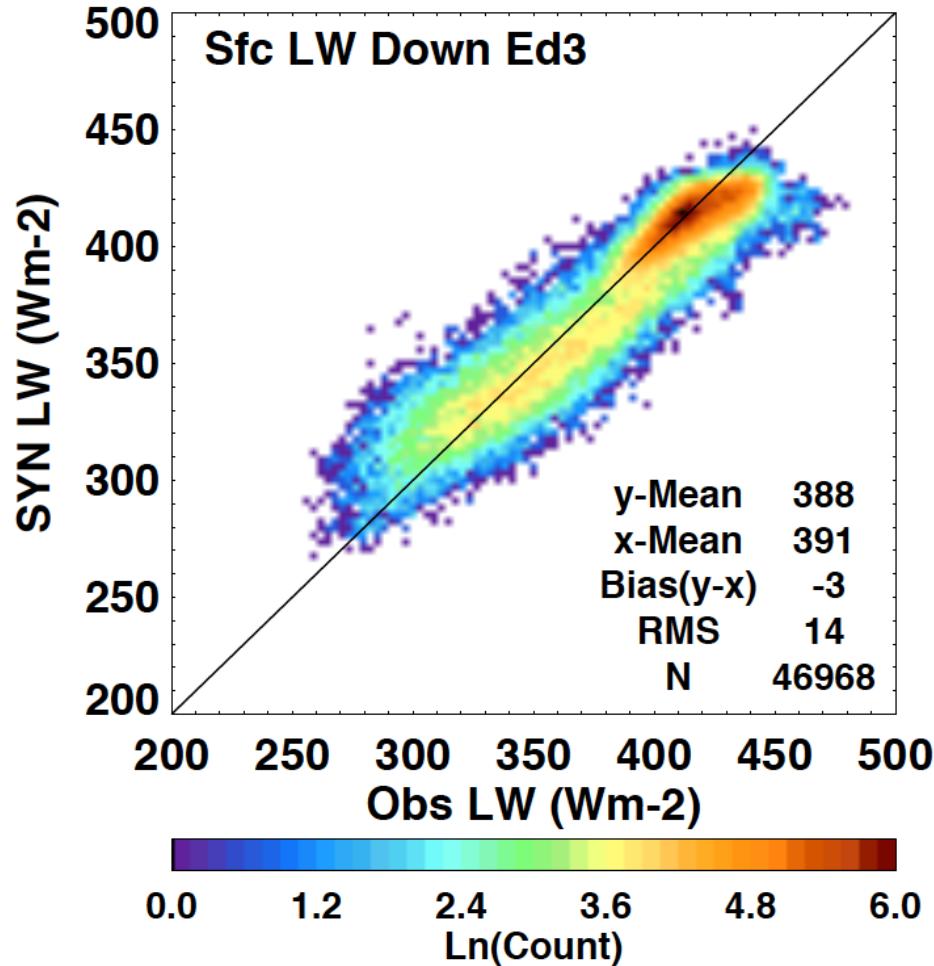
- GEO cloud retrieval used more than 2 channels
 - 1 hourly retrieval compared to 3 hourly
 - Nighttime longwave flux improvements
- Southern ocean

Improvements of nighttime surface longwave irradiance (Eastern Pacific)



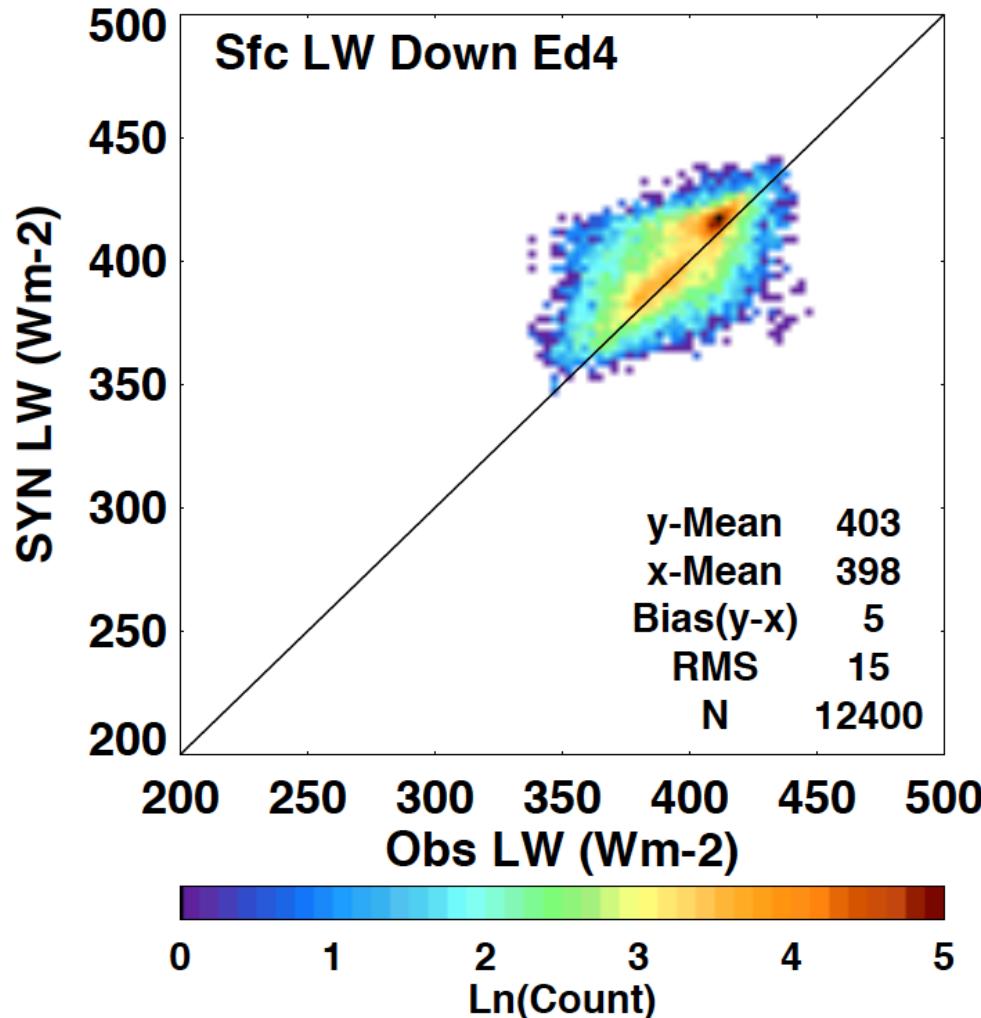
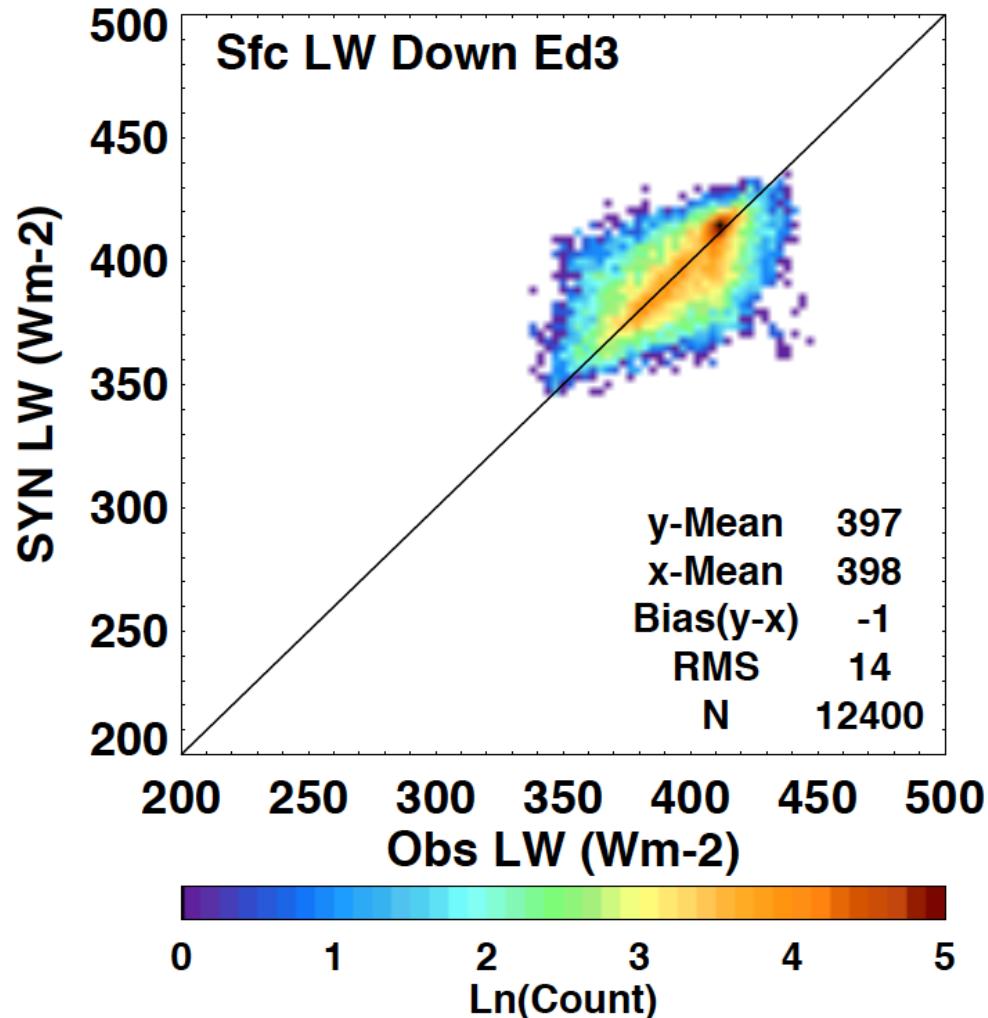
Western Pacific

Nighttime Surface LW Down Hourly (MTSAT W Pac Ocean Buoy Group, 08 Sites)



Atlantic ocean

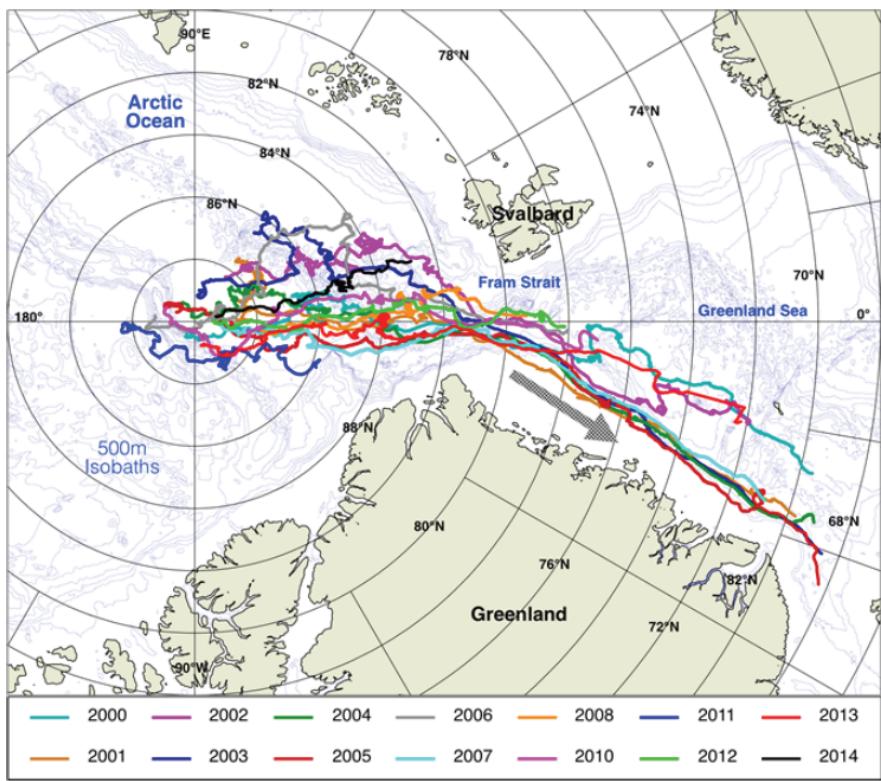
Nighttime Surface LW Down Hourly (MeteoSat Atl Ocean Buoy Group, 11 Sites)



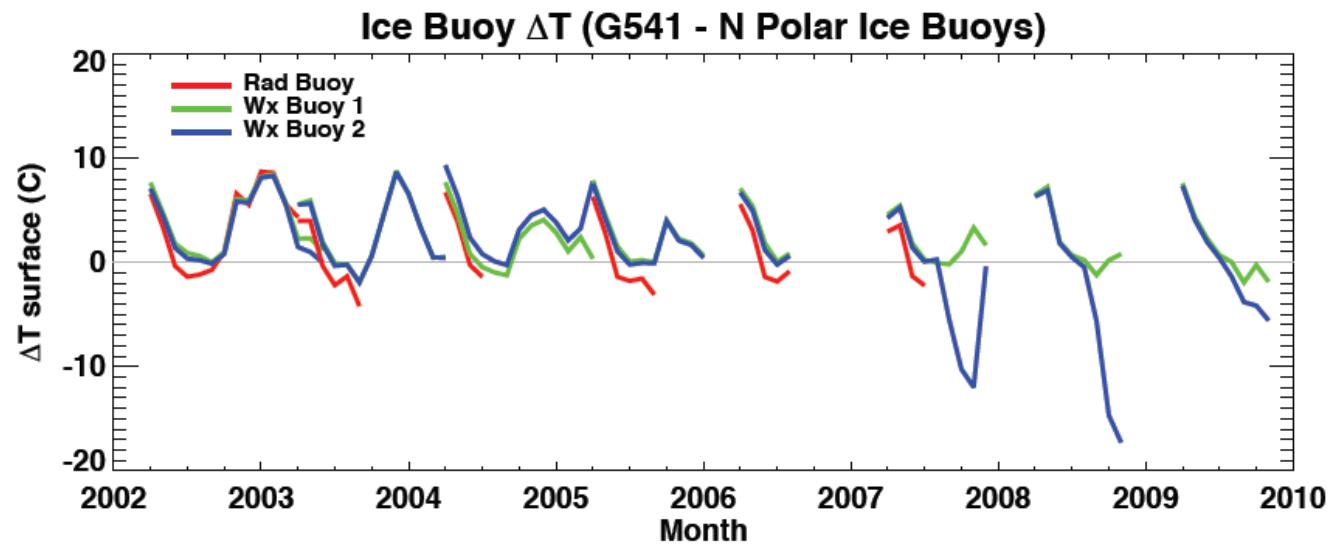
MET-10 algorithm changed beginning of 2013

North Polar Environmental Observatory (Ice buoys)

<http://psc.apl.washington.edu/northpole/Buoys.html>



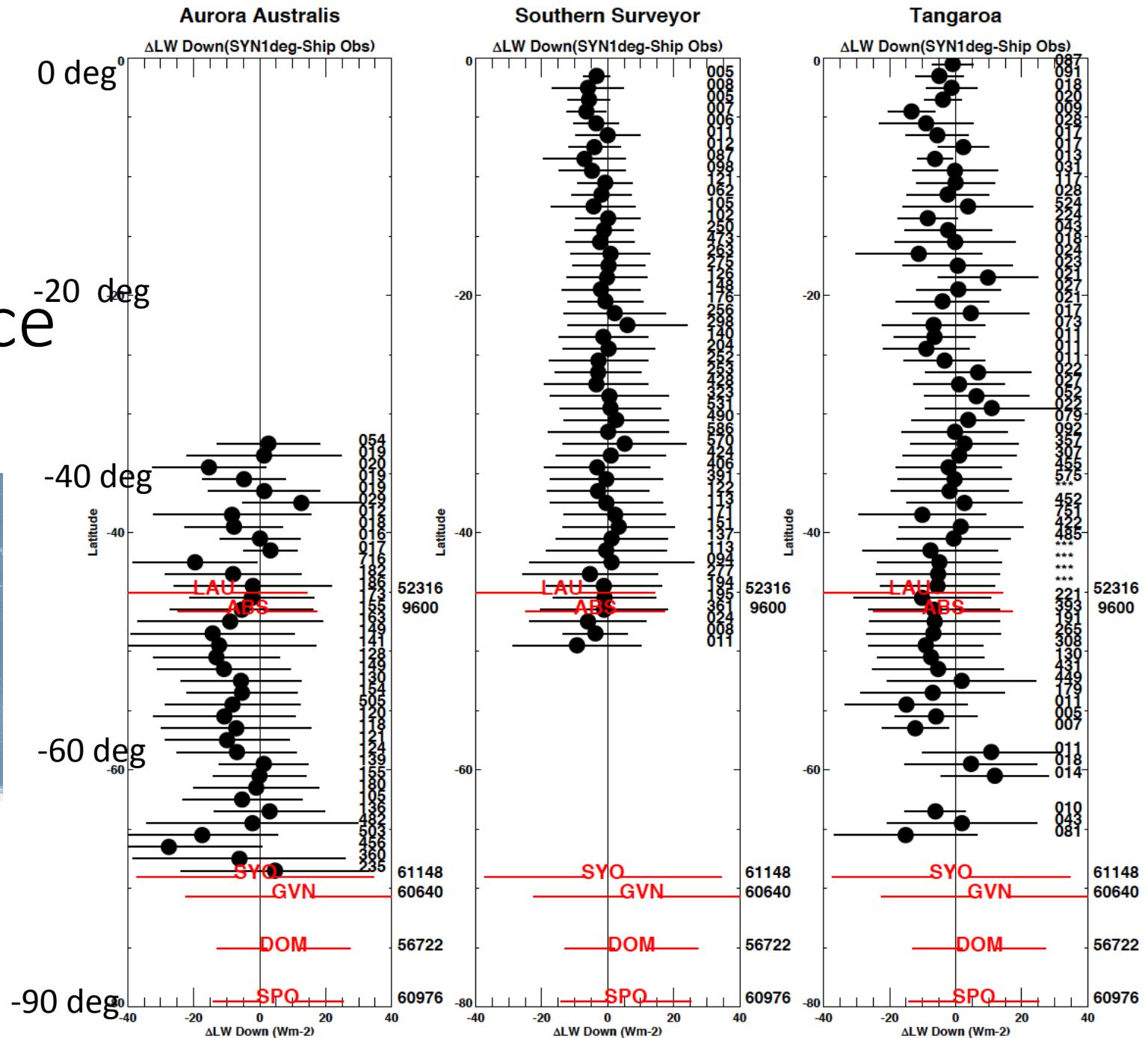
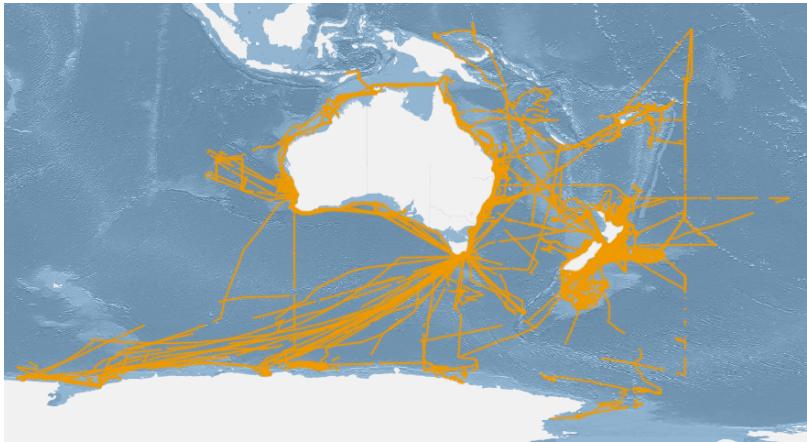
Surface air temperature



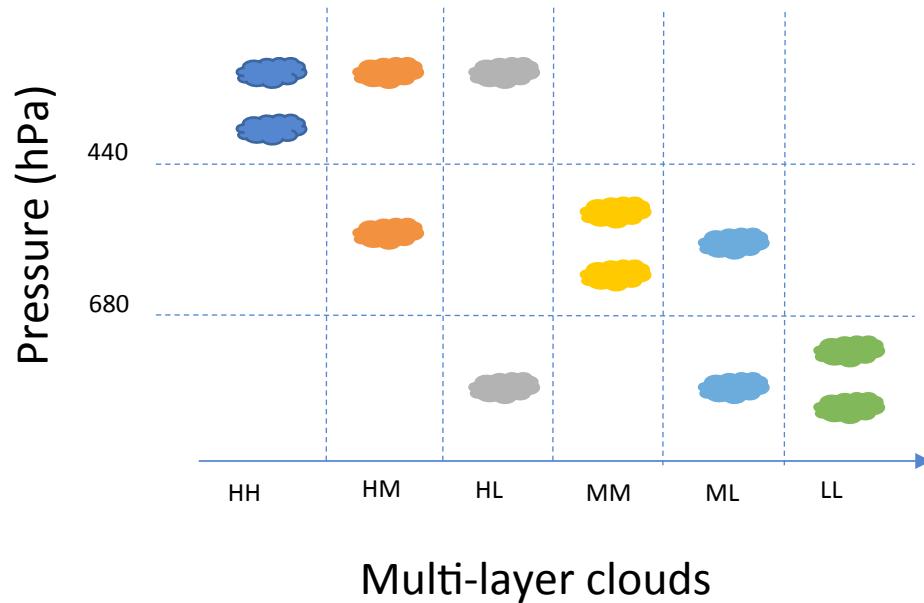
SYN1deg – NPEO buoy observations

Bias (RMS) Wm^{-2}	2002	2003	2004	2005	2006	2007	2008
LW down (day)	-10 (23)	-7 (21)	-2 (23)	-65 (77)	-11 (27)	-1 (20)	-13 (23)
LW down (night)	4 (24)						-22 (30)
SW down	15 (43)	59 (85)	53 (69)	24 (54)	49 (69)	13 (47)	22 (45)
N hours, day (night)	2211 (3757)	3284	1879	2391	2439	2206	3664

Southern ocean ship data Downward longwave irradiance



Evaluation of multi-layer clouds



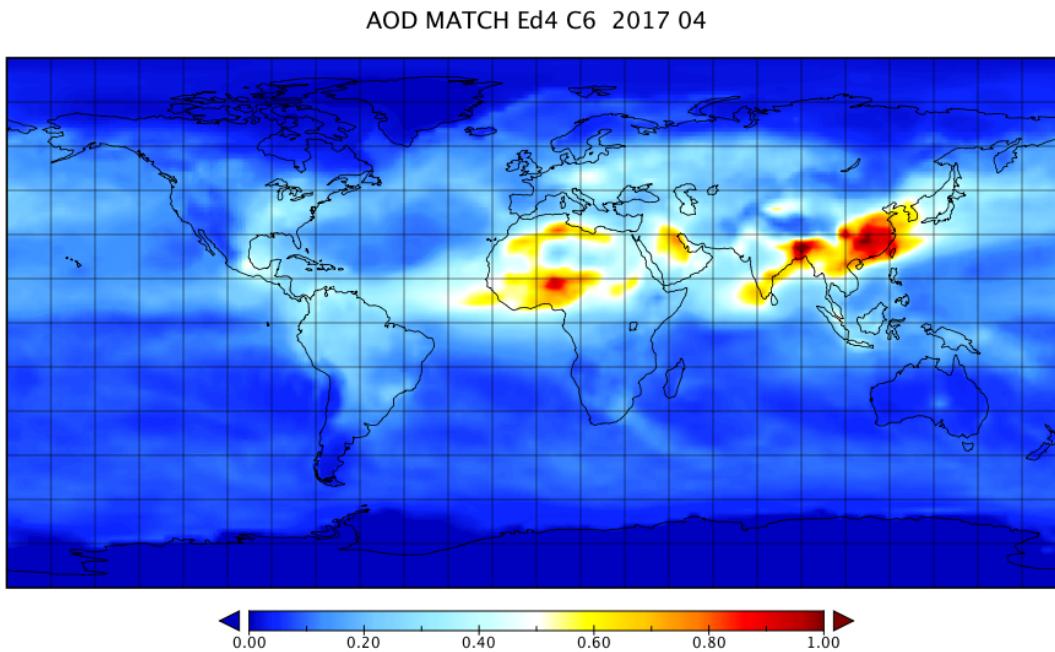
Separation of between cloud base and cloud top needs to be greater than 1 km
On average, footprints contains these multi-layers with the cloud fraction of 100% are 5.3% of all footprints

Multi-layer effect on surface downward longwave irradiance
CRS: Multi-layer is treated as a single layer
C3M: Multi-layer is derived from CALIPSO and CloudSat

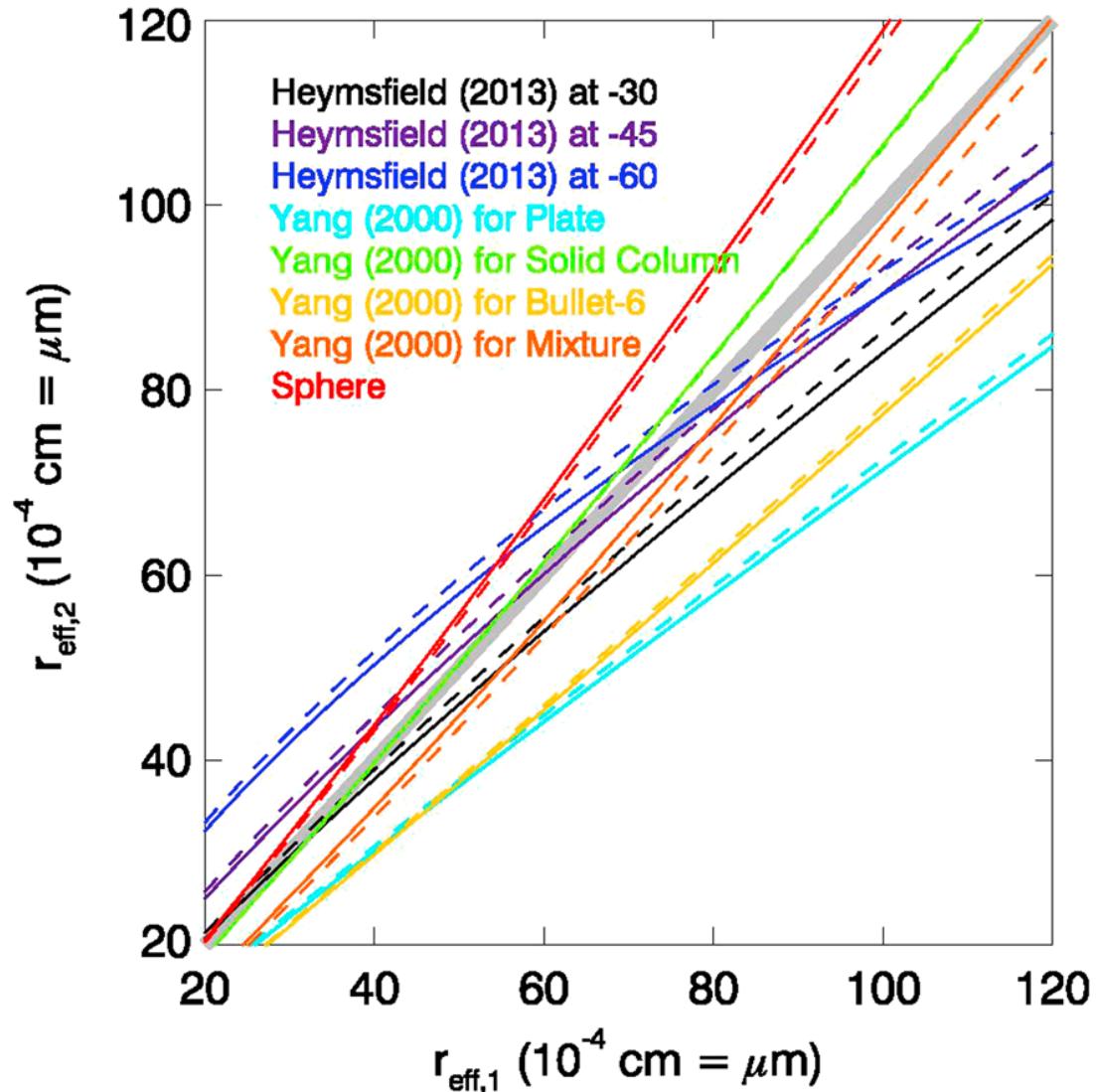
	Occurrence (%)	CRS-C3M (Wm^{-2})	LW flux mean (Wm^{-2})
HH	12.1	-0.8	322
HM	22.3	-7.5	304
HL	56.1	-7.7	320
MM	0.8	-7.3	242
ML	8.7	-8.2	269
LL	0.1	-4.9	282

MATCH Status

- Switch from MODIS Collection 5 to MODIS Collection 6
- 6 month C5/C6 overlap Oct 2016 – Mar 2017
- Decrease data latency to ~ 1 month (April 2017 shown below)
- Continued comparisons to MERRA2 aerosol



Ice particles size conversion



Reff1:
 $\text{mass}(D) = aD^b$:
 $\text{area}(D) = rD^d$
Where
D: Diameter in cm
 $a = 0.146 \text{ (g cm)}^{-b}$
 $b = 2.80$
 $r = (\text{g cm}^2)^{-d}$
 $d = 1.97$

Publications

- Ham, S.-H., S. Kato, F. G. Rose, 2017: Examining impacts of mass-diameter (m-D) and area-diameter (A-D) relationship of ice particles on retrievals of effective radius and ice water content from radar and lidar measurements, *J. Geophys. Res.*, doi: 10.1002/2016JD025672.
- Ham, S. H., S. Kato, F. G. Rose, D. Winker, T. L'Ecuyer, G. G. Mace, D. Painemal, S. Sun-Mack, Y. Chen, and W. F. Miller, 2017: Cloud occurrence and cloud radiative effects (CREs) from CCCM and CloudSat Radar-Lidar Products, submitted to *J. Geophysic. Res.*
- Radkevich, A., 2017: Iterative discrete ordinates solution of the equation for the surface reflected radiance, submitted to *Journal of Quantitative Spectroscopy and Radiative Transfer*.